

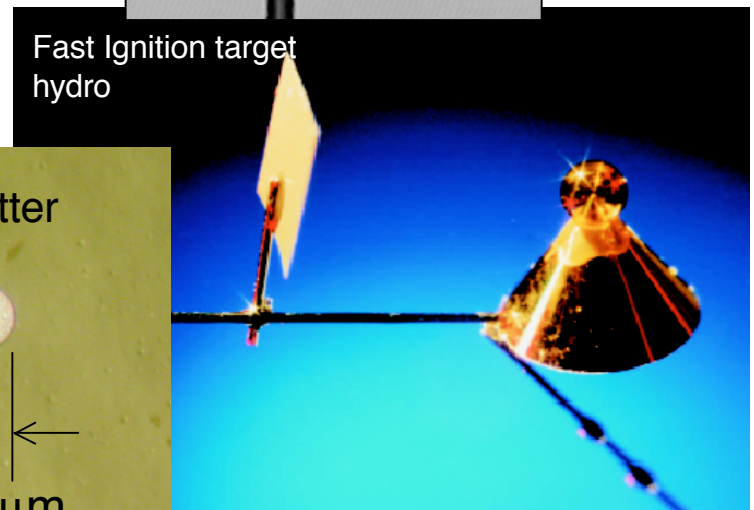
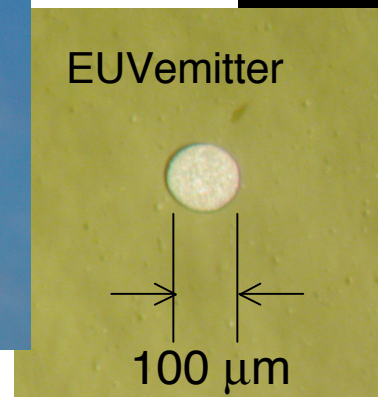
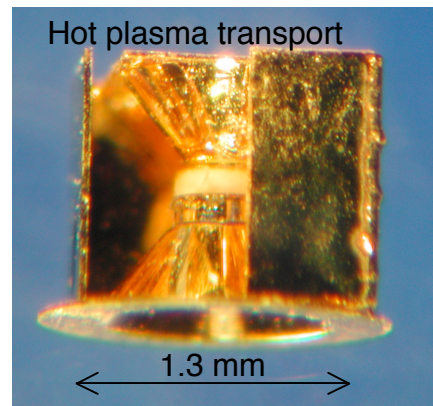
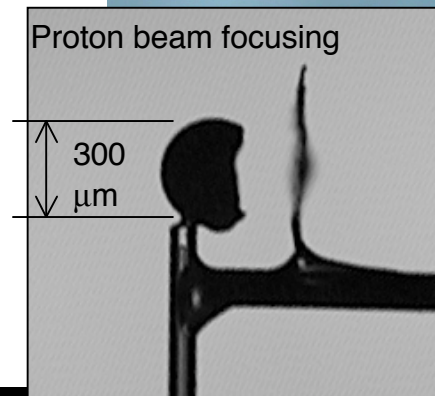
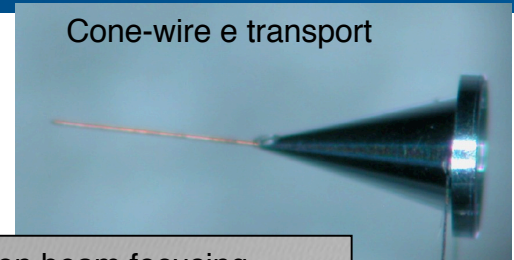
Targets for Rep-rated Lasers

**Rich Stephens
Neil Alexander, and Dan Goodin
General Atomics**

**3rd International Workshop on High Energy class Diode-
pumped Solid State Lasers
Livermore, CA
19 May 2006**

Targets are currently used in small numbers

- Made a few at a time
- Many are 3-D structures
- Individually assembled and characterized
- Individually inserted and aligned

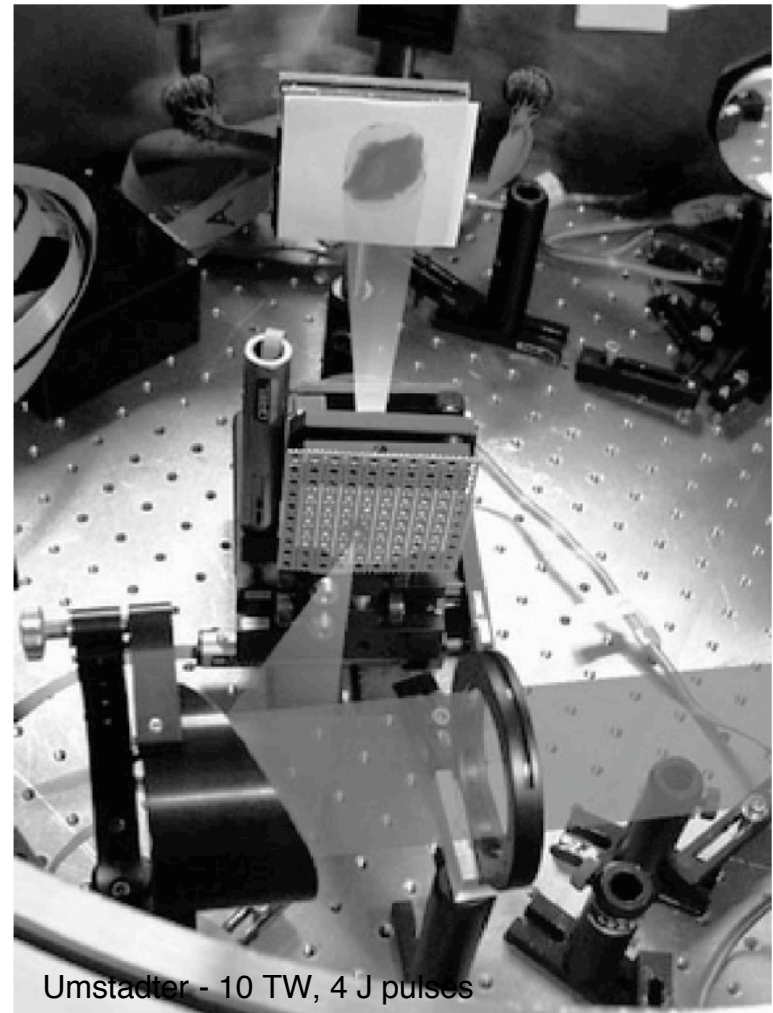


Rep-rated lasers require a new approach

- **Characteristics**
 - Many more targets
 - Rapid insertion and alignment
- **Suggests**
 - Mass operations
 - Automatic handling
- **Maintain**
 - flexibility in target design
 - 3-D structures

Low powered lasers can just use a grid

- **Targets are not affected by nearby shots**



LALTI[†] system will be higher power



[†]Laboratory for Advanced Laser Target Interactions



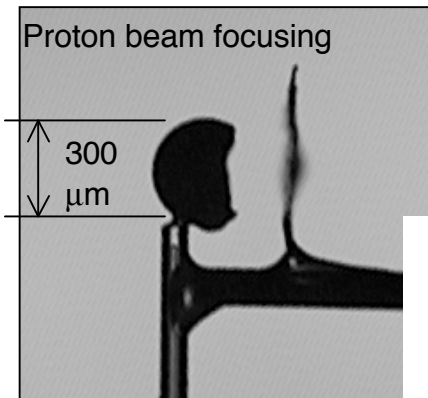
- **Laser pulses**
 - $E \sim 10-100$ J,
 - $T \sim 100-300$ fs
 - $I \sim 10^{20}$ W/cm²
- **Initial Shot rate**
 - 10 shots/hr
 - 50 shots/day (6000 targets/yr)
- **Developed shot rate**
 - 1 shot/second
 - 1000 shots/day

Requires

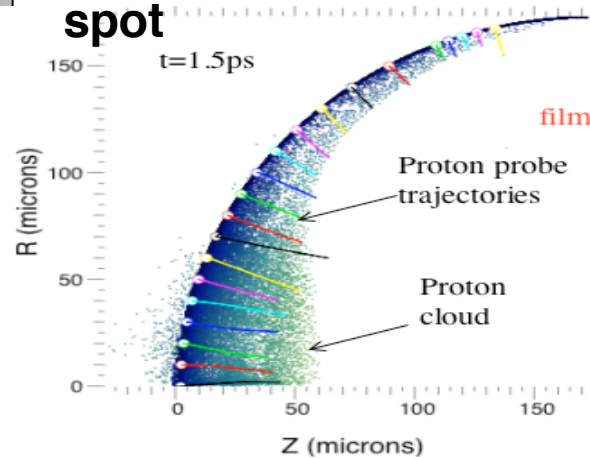
- Separation and protection of targets
- Cheap targets
- Mass Production

Targets must be precisely placed

proton accelerating surface



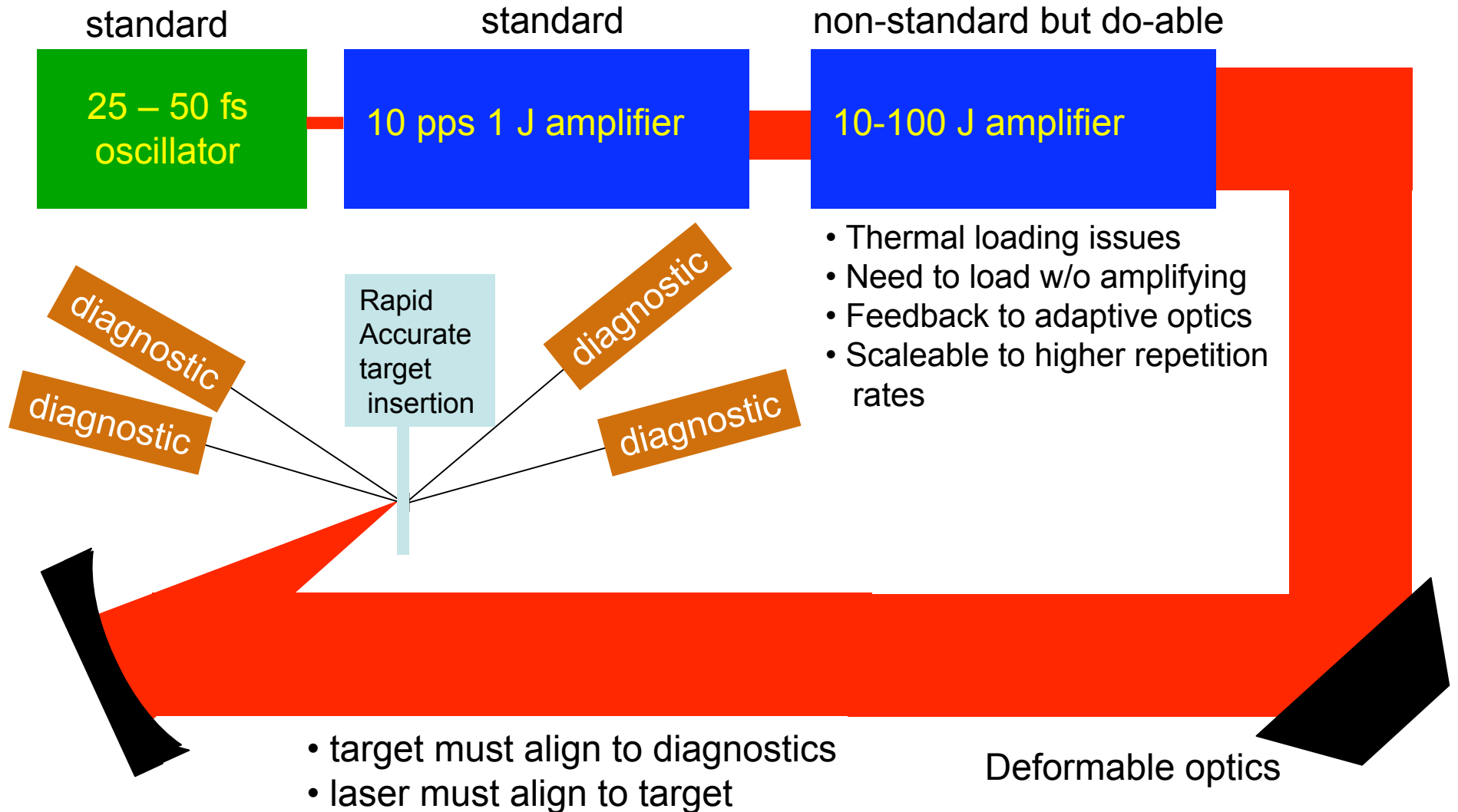
Is deformed by laser spot



Requiring aberration correction

And precise placement relative to laser beam

Laser, diagnostics, and target come to common center

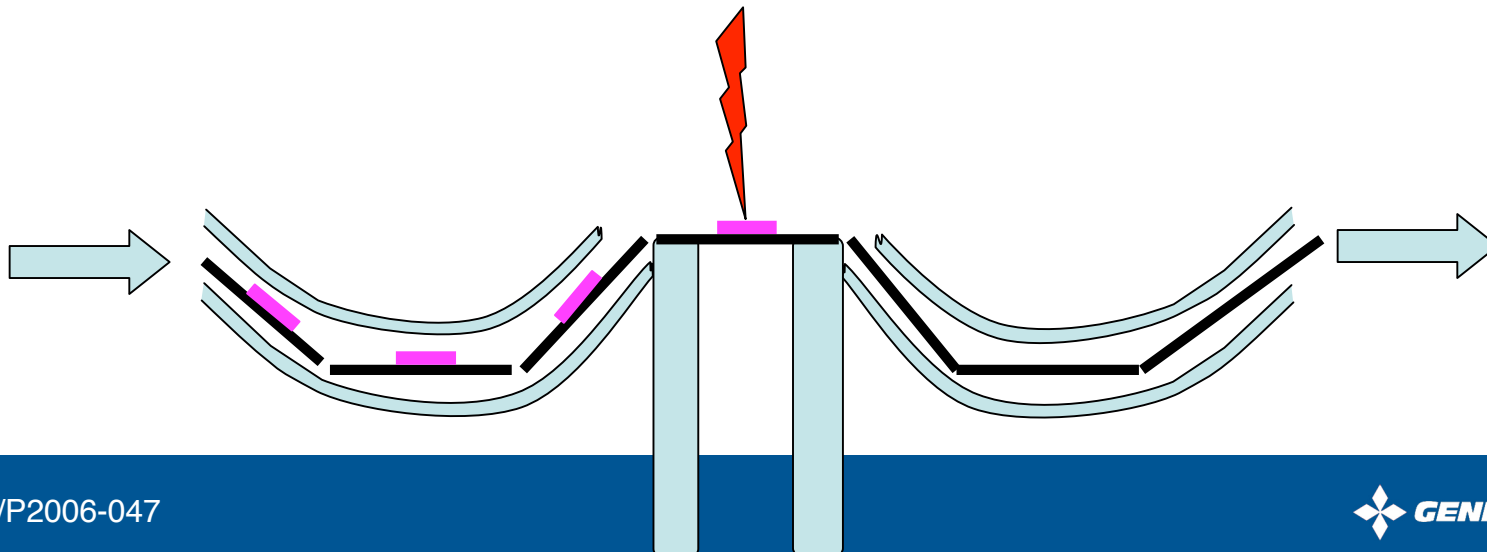


Each step in the targeting system must be integrated

- Mass target production
- Auto pick & place onto carriers
- Target location measured relative to carrier
- Chain-linked carriers for insertion

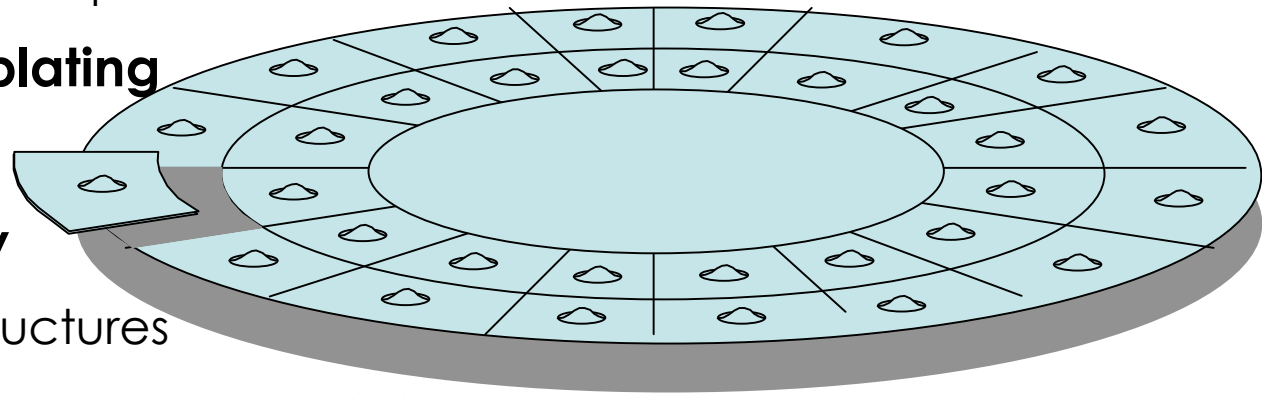
The end result is a chain of targets brought one-by-one to the shot point

— Must be fast & accurate



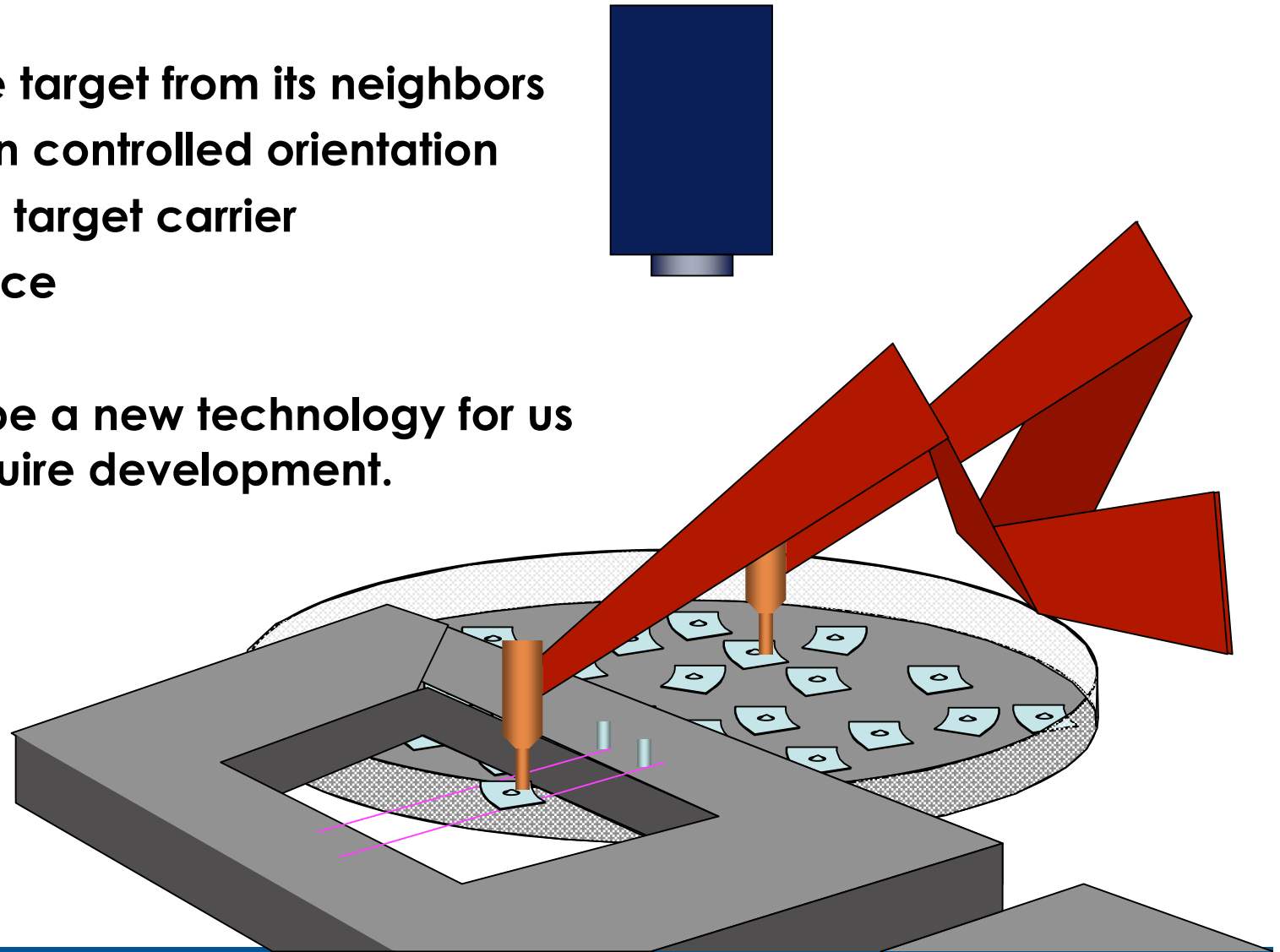
Mass produce and dice for large target numbers

- **Single point diamond turning on a lathe**
 - Use a thick substrate for stable support
 - Fast tool servo produces individual structures
 - Single point diamond produces smooth surfaces
- **Sputtering, electroplating**
 - Adds layers
- **E-beam lithography**
 - Adds individual structures
- **Laser or electric-discharge machining**
 - Produce divots or holes
- **Milling**
 - Separates individual targets



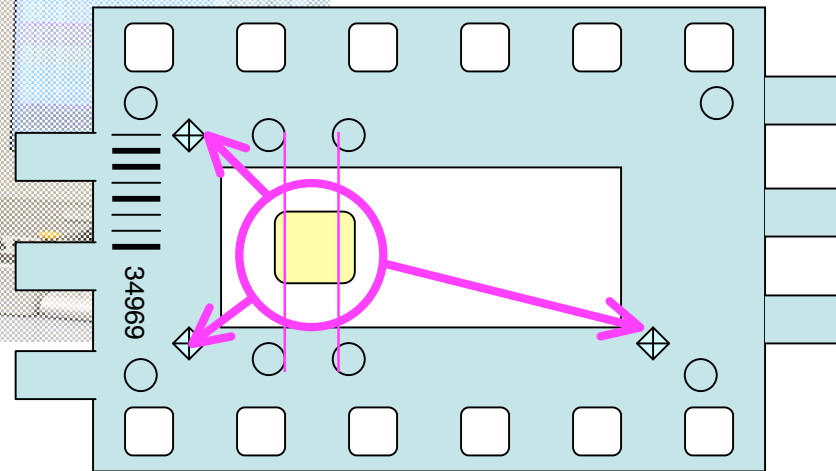
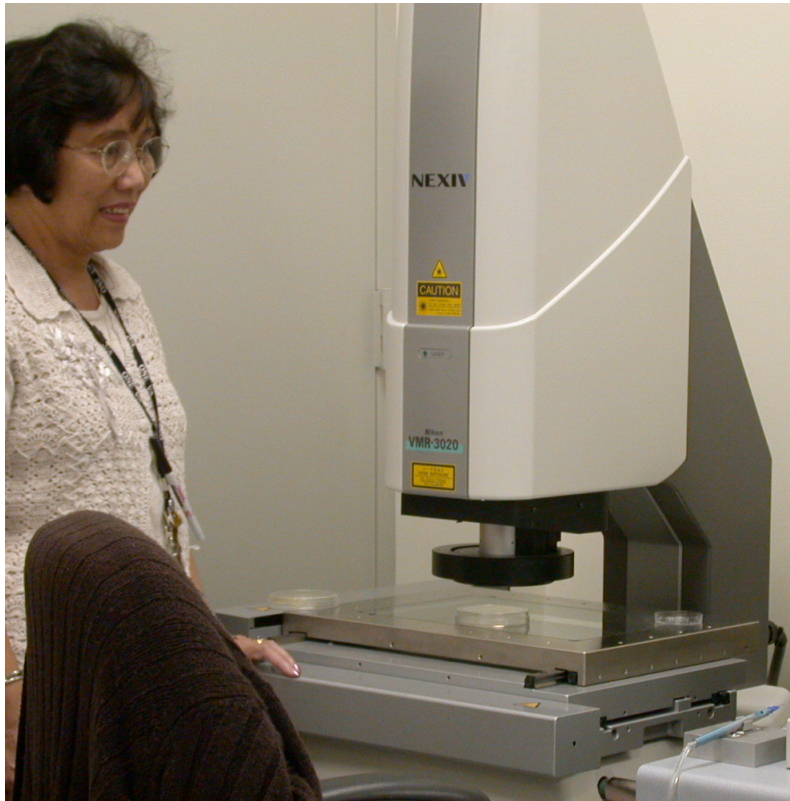
Targets assembled with automated pick & place

- Separate target from its neighbors
- Pick up in controlled orientation
- Place on target carrier
- Fix in place
- This will be a new technology for us
 - will require development.

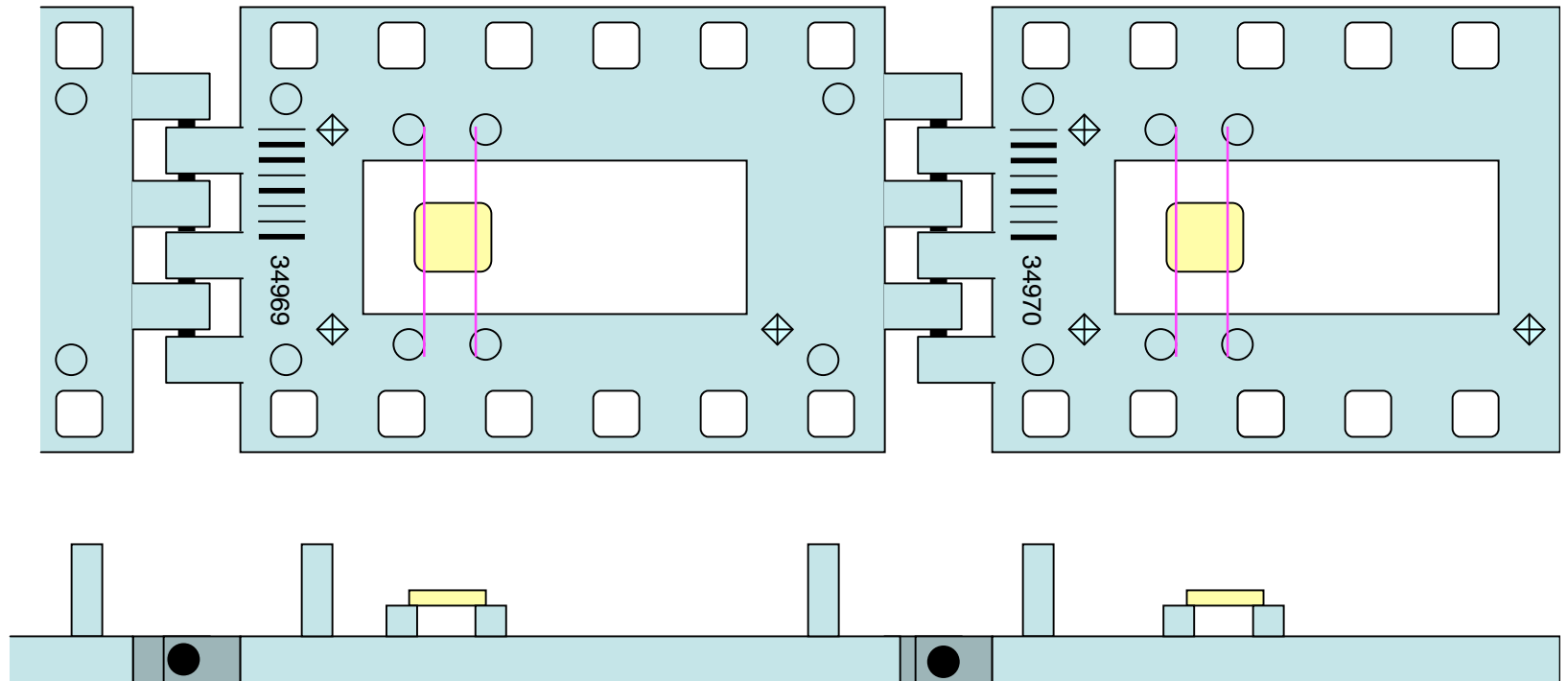


Automated microscopy characterizes assembly

- Existing equipment characterizes arrays of shells
- Can find patterns with 1 μm precision - relate to carrier fiducials
- Outputs measurement results to data file.

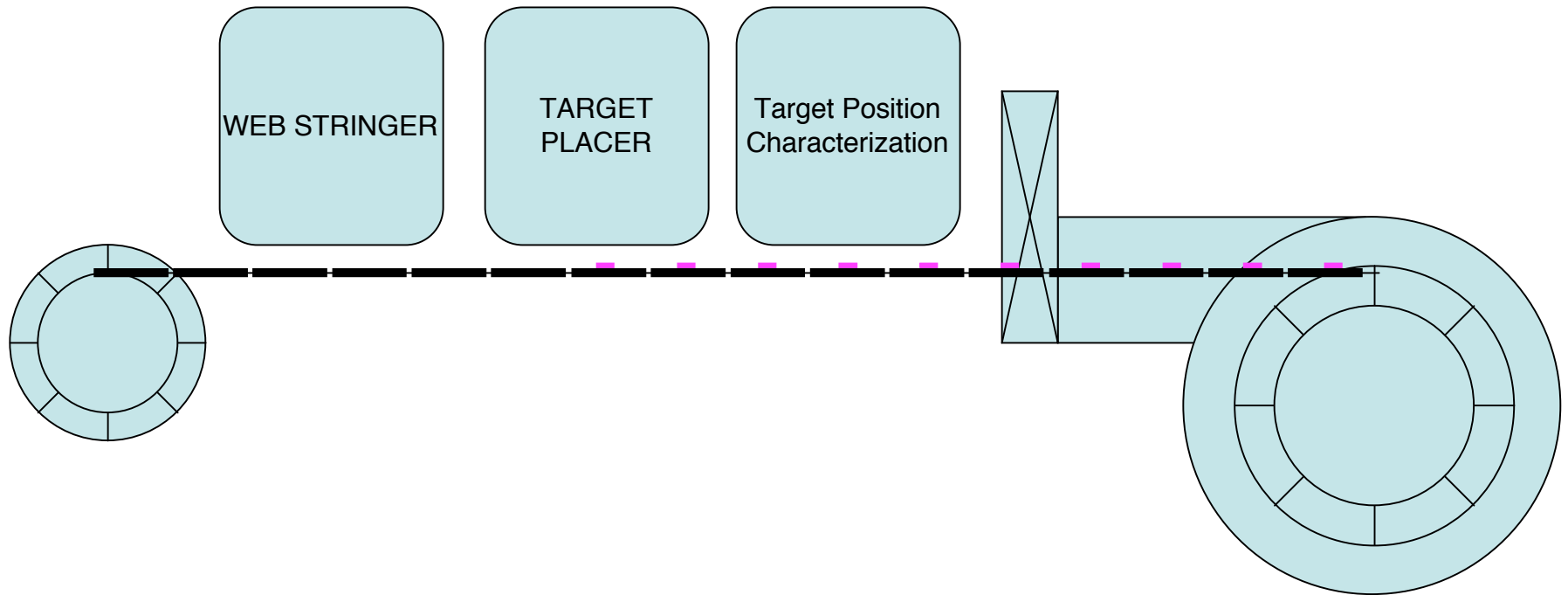


Common carrier is used to carry many target types



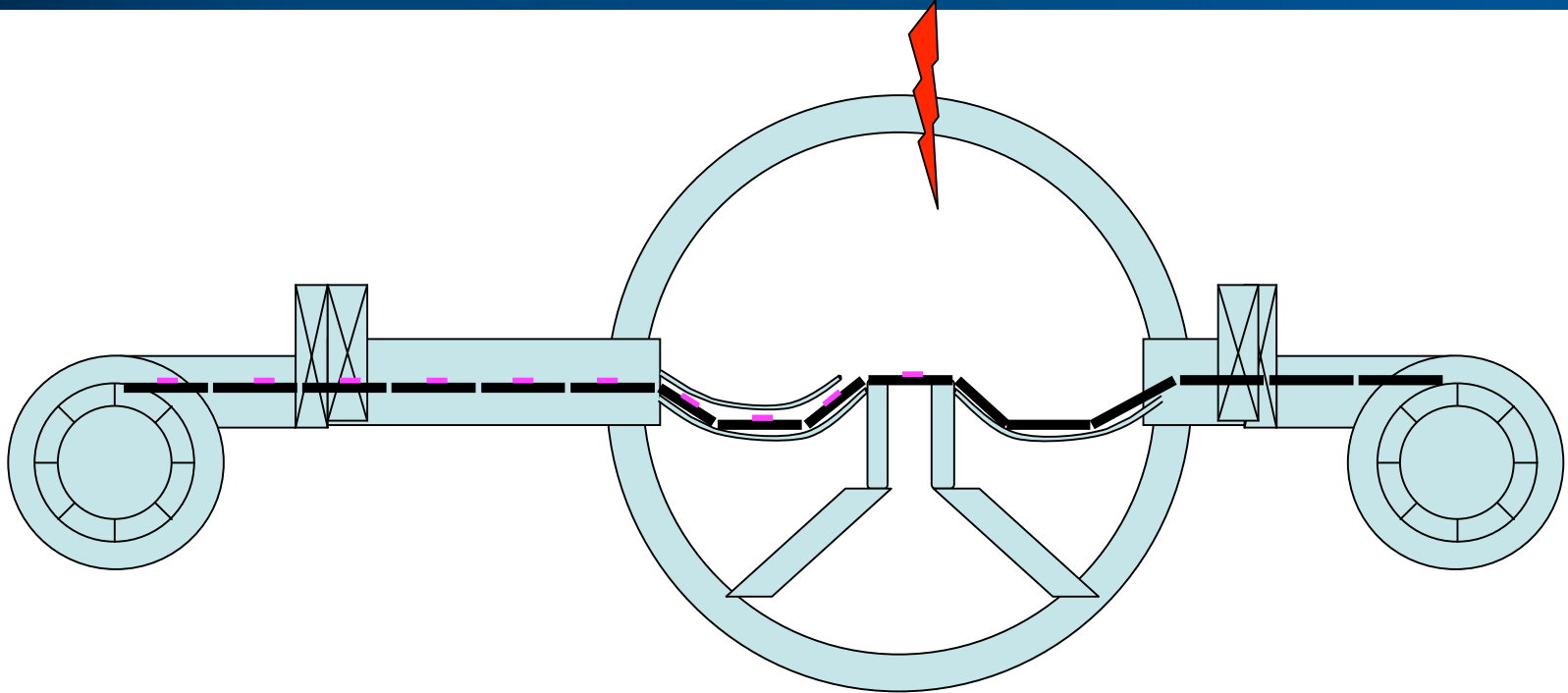
- Long posts to separate belts in reel
- Fiducials for target insertion in plate, and alignment in chamber
- Identifier to specify target
- Sprockets for handling - transport and alignment

Targets on reels can be put into target chamber without opening



- Target located with reference to fiducials
- Location and kind associated with plate id number
- Linked targets reeled into portable vacuum chamber

Target carriers are placed on a central alignment system



- **Adjacent targets are shielded from laser shot**
- **Translation stage positions target at based on fiducial position**
 - Uses actual target location based on characterization data
- **Target is aligned by fiducials - independent of target type**
- **Motors, etc have to be turned off during shot**

Each target type takes some planning

- **Planar multilayers - metal & solid plastic**
- **Planar including foam**
- **Thickness steps**
- **Windows access holes**
- **Multi planes**
- **Isolated Surface structures - bumps, divots**
- **Repeated surface structures**
- **??????? - you name it (please)**